

Phase-Field Simulations for Microstructural Evolution: From Metals to Biomaterials

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Abstract: Controlling microstructures in multiphase or composite materials is one of the primary routes for materials design for optimal performance. Phase-field models, which are based on the diffuse interface approach, have proven useful in simulating and predicting the evolution of microstructures in many material systems. This lecture will cover the fundamental background of this approach, including the physics and mathematics behind the formulation. In particular, thermodynamics and kinetics of materials will be reviewed. Several applications will be briefly discussed to demonstrate the method's capabilities, including coarsening of complex microstructures, morphological evolution of biomembranes, nanostructure formation, and battery charge/discharge processes.